

11. A composition of water and dissolved solutes, said composition produced by a process of treatment of a feedwater stream in membrane separation equipment, wherein said membrane separation equipment comprises at least one unit having a membrane separator, and wherein said process of treatment produces a low solute containing product water stream and a high solute containing reject stream, wherein said process comprises:

(a) providing a feedwater stream containing solutes therein, said solutes comprising

(i) hardness,

(ii) alkalinity, and

(iii) at least one molecular species which is sparingly ionized when in neutral or near neutral pH aqueous solution;

(b) concentrating said feedwater stream in a first unit of said membrane separation equipment after reducing the tendency of said feedwater to form scale when said feedwater is concentrated to a preselected concentration factor at a selected pH, by effecting, in any order, two or more of the following:

(i) removing hardness from said feedwater stream;

(ii) removing substantially all alkalinity associated with hardness from said feedwater stream;

(iii) removing dissolved gas from said feedwater stream, whether initially present or created during said hardness or said alkalinity removal step;

(c) raising the pH of the product from step (a) to a selected pH of at least about 8.5, to urge said at least one molecular species which is sparingly ionized when in neutral or near neutral pH aqueous solution toward increased ionization;

(d) passing the product from step (c) above through said membrane separation equipment, said membrane separation equipment substantially resisting passage of dissolved species therethrough, said membrane rejecting said at least one molecular species which is sparingly ionized when in neutral or near neutral pH aqueous solution by at least 95% while concentrating said feedwater to said preselected concentration factor, to produce

- (i) a high solute containing reject stream, and
- (ii) a low solute containing water product stream.

12. A composition of water and dissolved solutes, said composition produced by a process of treatment of a feedwater stream in membrane separation equipment, wherein said membrane separation equipment comprises at least one unit having a membrane separator, and wherein said process of treatment produces a low solute containing product water stream and a high solute containing reject stream, wherein said process comprises:

(a) providing a feedwater stream containing solutes therein, said solutes comprising

- (i) hardness,

(ii) alkalinity, and

(iii) at least one molecular species which is sparingly ionized when in neutral or near neutral pH aqueous solution;

(b) concentrating said feedwater stream in a first unit of said membrane separation equipment after reducing the tendency of said feedwater to form scale when said feedwater is concentrated to a preselected concentration factor at a selected pH, by effecting, in any order, two or more of the following:

(i) removing hardness from said feedwater stream;

(ii) removing substantially all non-hydroxide alkalinity associated with hardness from said feedwater stream;

(iii) removing dissolved gas from said feedwater stream, whether initially present or created during said hardness or said alkalinity removal step;

(c) raising the pH of the product from step (a) to a selected pH of at least about 8.5, to urge said at least one molecular species which is sparingly ionized when in neutral or near neutral pH aqueous solution toward increased ionization;

(d) passing the product from step (c) above through said membrane separation equipment, said membrane separation equipment substantially resisting passage of dissolved species therethrough, to concentrate said feedwater to said preselected concentration factor, to produce

(i) a high solute containing reject stream, and

(ii) a low solute containing product water stream.

13. A composition of water and dissolved solutes, said composition produced according to the process of claim 11, or of claim 12, wherein said feedwater stream comprises at least some Total Organic Carbon, and wherein said product water stream comprises at least some Total Organic Carbon, and wherein said Total Organic Carbon in said product water product stream is less than one percent of the Total Organic Carbon in said feedwater stream.

14. A composition of water and dissolved solutes, said composition produced according to the process of claim 13, wherein the Total Organic Carbon in said product water stream is less than 0.4% of the Total Organic Carbon in said feedwater stream.

15. A composition of water and dissolved solutes, said composition produced according to the process of claim 13, wherein the Total Organic Carbon in said product water stream is less than 0.34% of the Total Organic Carbon in said feedwater stream.

16. A composition of water and dissolved solutes, said composition produced according to the process of claim 11, or of claim 12, wherein

(a) said feedwater stream further comprises boron, and wherein said product water stream is characterized by having a boron content of less than about two percent (2%) of the boron content of said feedwater stream; and

(b) said feedwater stream comprises at least some Total Organic Carbon, and wherein said product water stream comprises at least some Total Organic Carbon, and wherein said Total Organic Carbon in said product water product stream is less than one percent of the Total Organic Carbon in said feedwater stream.

17. A composition of water and dissolved solutes, said composition produced according to the process of claim 11, or of claim 12, wherein

(a) said feedwater stream further comprises boron, and wherein said product water stream is characterized by having a boron content of about one and one-half percent (1.5%), or less, of the boron content of said feedwater stream; and

(b) said feedwater stream comprises at least some Total Organic Carbon, and wherein said product water stream comprises at least some Total Organic Carbon, and wherein said Total Organic Carbon in said product water product stream is less than one percent of the Total Organic Carbon in said feedwater stream.

18. A composition of water and dissolved solutes, said water produced according to the process of claim 11, or of claim 12, wherein

(a) said feedwater stream further comprises boron, and wherein said product water stream is characterized by having a boron content of about one percent (1%), or less, of the boron content of said feedwater stream; and

(b) said feedwater stream comprises at least some Total Organic Carbon, and wherein said product water stream comprises at least some Total Organic Carbon, and wherein said Total Organic Carbon in said product water stream is less than one percent of the Total Organic Carbon in said feedwater stream.

19. A composition of water and dissolved solutes, said composition produced according to the process of claim 16, wherein said Total Organic Carbon in said product water stream is less than 0.4% of the Total Organic Carbon in said feedwater stream.

20. A composition of water and dissolved solutes, said composition produced according to the process of claim 17, wherein said Total Organic Carbon in said product water stream is less than 0.4% of the Total Organic Carbon in said feedwater stream.

21. A composition of water and dissolved solutes, said composition produced according to the process of claim 18, wherein said Total Organic Carbon in said product water stream is less than 0.4% of the Total Organic Carbon in said feedwater stream.

22. A composition of water and dissolved solutes, said composition produced according to the process of claim 16, wherein said Total Organic Carbon in said product water stream is less than 0.34% of the Total Organic Carbon in said feedwater stream.

23. A composition of water and dissolved solutes, said composition produced according to the process of claim 17, wherein said Total Organic Carbon in said product water stream is less than 0.34% of the Total Organic Carbon in said feedwater stream.

24. A composition of water and dissolved solutes, said composition produced according to the process of claim 18, wherein said Total Organic Carbon in said product water stream is less than 0.34% of the Total Organic Carbon in said feedwater stream.

25. A composition of water and dissolved solutes, said composition produced according to the process of claim 11, or of claim 12, wherein said feedwater stream further comprises silica, and wherein said product water stream is characterized by having a

silica content of less than about 0.05% of the silica content of said feedwater stream.

26. A composition of water and dissolved solutes, said composition produced according to the process of claim 16, wherein said feedwater stream further comprises silica, and wherein said product water stream is characterized by having a silica content of less than about 0.05% of the silica content of said feedwater stream.

27. A composition of water and dissolved solutes, said composition produced according to the process of claim 17, wherein said feedwater stream further comprises silica, and wherein said product water stream is characterized by having a silica content of less than about 0.05% of the silica content of said feedwater stream.

28. A composition of water and dissolved solutes, said composition produced according to the process of claim 18, wherein said feedwater stream further comprises silica, and wherein said product water stream is characterized by having a silica content of less than about 0.05% of the silica content of said feedwater stream.



29. A composition of water and dissolved solutes, said composition produced according to the process of claim 11, or of claim 12, wherein said feedwater stream further comprises bacteria, and wherein said product water stream is characterized by having essentially zero bacteria content.

30. A composition of water and dissolved solutes, said composition produced according to the process of claim 16, wherein said feedwater stream further comprises bacteria, and wherein said product water stream is characterized by having essentially zero bacteria content.

31. A composition of water and dissolved solutes, said composition produced according to the process of claim 17, wherein said feedwater stream further comprises bacteria, and wherein said product water stream is characterized by having essentially zero bacteria content.

32. A composition of water and dissolved solutes, said composition produced according to the process of claim 18, wherein said feedwater stream further comprises bacteria, and wherein said product water stream is characterized by having essentially zero bacteria content.

33. A composition of water and dissolved solutes, said composition produced according to the process of claim 11, or of claim 12, wherein said feedwater stream further comprises live viruses, and wherein said product water stream is characterized by having essentially zero live viruses therein.

34. A composition of water and dissolved solutes, said composition produced according to the process of claim 16, wherein said feedwater stream further comprises live viruses, and wherein said product water stream is characterized by having essentially zero live viruses therein.

35. A composition of water and dissolved solutes, said composition produced according to the process of claim 17, wherein said feedwater stream further comprises live viruses, and wherein said product water stream is characterized by having essentially zero live viruses therein.

36. A composition of water and dissolved solutes, said composition produced according to the process of claim 18, wherein said feedwater stream further comprises live viruses, and wherein said product water stream is characterized by having essentially zero live viruses therein.